October 16, 2012

Independent Peer Review Group (IPRG) Report No. 1

Comments on Southern California Edison's San Onofre Nuclear Generating (SONGS) Seismic Research Projects

Background

In 2006, the California Legislature enacted Assembly Bill (AB) 1632, which was codified as Public Resources Code Section 25303. AB 1632 directed the California Energy Commission (CEC) to assess the potential vulnerability of California's largest baseload power plants, which includes the San Onofre Nuclear Generating Station (SONGS), to a major disruption due to a major seismic event and other issues. In response to AB 1632, in November 2008 the CEC issued its findings and recommendations in its AB 1632 Report, which was part of its 2008 Integrated Energy Policy Report Update.

Specific to SONGS, the CEC recommended that Southern California Edison (SCE) should develop an active seismic hazards research program that "…*should prioritize and include further investigations into the seismic setting at SONGS and should assess whether recent or current seismic, geologic, or ground motion research in the vicinity of SONGS has implications for the long-term seismic vulnerability of the plant".* Furthermore, the CEC also recommended"…*that SCE should use the three-dimensional seismic reflection mapping, other techniques, and a permanent GPS array for resolving seismic uncertainties for SONGS."*

In General Rate Case Decision D.12-05-004, the California Public Utilities Commission (CPUC) approved $64M in funding for the ongoing seismic program and new seismic research projects and incorporate the recommendations from the AB 1632 Report into its feasibility study to extend the operating licenses of its Units 2 and 3 at SONGS.

IPRG Panel

Decision D.12-05-004 concluded that independent peer review of SCE's study plans and findings/results of seismic studies was reasonable, and ordered the CPUC Energy Division Director to coordinate an Independent Peer Review Group (IPRG) composed of representatives from six state agencies, as well as outside experts, for that purpose.

Therefore, under the auspices of the CPUC, the IPRG is conducting an independent review of SCE's seismic studies including independently reviewing and commenting on SCE's study plan and the findings of their studies.

On September 21, 2012, SCE met with members of the IPRG to provide an overview of the SONGS Seismic Research Projects Program. CPUC staff from Energy Division attended, as well as staff from the CEC, the California Geological Survey, the California Seismic Safety Commission, and the California Emergency Management Agency. At this meeting, representatives from SCE described their plans and rationale for ongoing and planned seismic research projects. The seismic research projects are designed to provide new information regarding the seismic and geologic setting at SONGS, specifically with respect to the Newport – Inglewood / Rose Canyon (NI/RC) fault zone and the Oceanside Blind Thrust (OBT) fault. The desired data from these projects will help refine the understanding of fault location, fault geometry, faulting style, slip rates, and recurrence intervals, all of which are important parameters in assessing seismic hazards at SONGS. Of particular interest is the nature of the intersection between the NI/RC and OBT faults, where the subsurface geometry is currently poorly understood. The geometry of this intersection has important implications to the seismic hazard analysis as it will help define the areal extent of the OBT (with consequences to modeled earthquake magnitude) and provide insights regarding how to model the interaction between the OBT and NI/RC faults.

SCE Seismic Research Projects Presentation

SCE's Seismic Research Projects are supported by a number of technical leaders, researchers and support staff from governmental agencies, academia, and private sector consultants, each with expertise in their respective fields. SCE also has convened a number of qualified researchers who will serve as peer reviewers. The project is divided into two components, an off-shore component and an onshore component, each with several subprojects. The subprojects are summarized below:

Offshore Projects

1. Historical Marine Geophysical Data Reprocessing and Reanalysis: This project is currently underway and involves the reprocessing and reanalysis of existing seismic reflection data, most of which was collected over 30 years ago. The data being reprocessed is located within the proposed 2-D Deep Geophysical Survey area and is intended to help identify targets within the proposed 2-D study area. Examples provided by SCE show that using modern techniques to reprocess existing seismic data can result in significant improvements in imaging of near-surface geology, improving resolution of shallow features, including shallow (young) faulting. However, significant improvement in the deep imaging is not possible due to limitations in the original data collection techniques. Furthermore, of the existing seismic data, only a limited amount is available in a raw digital format, which is needed for reprocessing. Other existing seismic data (which cannot be

reprocessed using modern techniques) are also being compiled and will be used in the analysis and planning for the 2-D surveys.

2. 2-D Deep Marine Seismic Reflection Survey: This project is currently in the planning and permitting stage. The goal of this project is to acquire new 2-D deep marine geophysical data in order to image the deep (8 – 12 km) geometry of offshore faults. The purpose of this project is two-fold: First, the acquisition of new 2-D seismic reflection data will image the geologic structure and offshore fault systems beneath the seafloor. These data, collected and analyzed by modern techniques, are likely to be of much higher quality and resolution than any existing data and will image deeper than surveys done in the past. Second, and perhaps more important, the results of this survey will determine whether a 3-D deep survey is warranted. Of particular importance is whether the 2-D deep survey can image faults within the Catalina schist, particularly to the depth where the OBT and NI/RC faults may intersect. In this regard, the 2-D study is in part a feasibility study for a future proposed 3-D survey, and if the 2-D survey is successful, it also will help define the scope and extent of the 3-D deep survey. Currently, SCE is considering reducing the scope of work by reducing the total time of data acquisition from 17 days to 10 days. This can be accomplished by reducing the number of planned strike lines (shore-parallel tie lines) from 14 lines to 6. The total area of the survey will remain the same, and the number of fault perpendicular lines (which provides the most useful data regarding fault geometry) has not changed. SCE believes that even with a reduced scope of work, the objectives of the project should not be adversely affected.
3. 3-D Deep Marine Seismic Reflection Survey: In the CEC AB 1632 report, the CEC recommended the use of 3-D seismic surveys as an approach to help resolve the uncertainties in the seismic hazard analysis at SONGS. As noted in item 2, the 2-D deep survey will be used to assess the feasibility of the 3-D deep survey, as well as help define targeted areas where SCE and its research team determine they have the best chance of success. This project is currently in the planning stages, as the results of the 2-D deep survey will be evaluated prior to moving forward with the 3-D survey and defining potential target areas.
4. 2-D Shallow Marine Seismic Reflection Survey: This project is complementary to the 2-D Deep survey, with the goal of collecting high resolution 2-D shallow data in order to image surficial and near-surficial deformation. Such data can be used to assess the style and recency of activity of shallow faults. In conjunction with relative or absolute dating constraints, 2-D data also can be used to estimate slip rates, particularly for faults with predominately vertical displacement, such as the OBT. As with the 2-D deep survey, the shallow 2-D survey will be used to plan the location and extent of the 3-D shallow survey.

5. 3-D Shallow Marine Seismic Reflection Survey: The goal of this project is to image the geometry and shallow deformational features related to the NI/RC and OBT faults. Targets may include offset channels related to the NI/RC faults, as well as shallow offset marker beds along the OBT, both which can be used to estimate slip rates if measured and dated. The target area(s) for this project will be based on the results of the shallow 2-D survey.
6. Seafloor Surveys: Bathymetry, gravity, and magnetic data will be collected concurrently with the deep and shallow seismic surveys. Such data may be useful in mapping the geomorphic expression of the NI/RC fault on the seafloor, and locating the fault from contrasting materials imaged through gravity and magnetic data.
7. Seafloor Sediment Sampling and Age Dating: Sediment samples will be collected for dating using gravity, piston and vibracores. The goal of this project is to date offset geologic layers imaged by the shallow seismic reflection surveys in order to determine slip rates and possibly earthquake recurrence on the NI/RC and OBT faults. This project is dependent on the results of the shallow seismic surveys that will look for potential targets for sampling.

Onshore Projects

1. GPS Monitoring: Install and monitor continuous GPS stations in order to densify the GPS network and monitor crustal deformation in the region surrounding SONGS. This project is underway and GPS stations have been installed and others are being permitted. SCE notes that the stations will become part of the Southern California Integrated GPS Network (SCIGN). This project follows the recommendation of the AB 1632 report, which recommends the use of GPS "…*for resolving seismic uncertainties for SONGS.*"
2. Marine Terrace and Coastal Deformation Investigations: This project is intended to quantify uplift rates along the coast and, potentially, separate the regional uplift signal from uplift related to the NI/RC and OBT faults. This will be done by compiling existing marine terrace data and age dating as well as new terrace mapping and age dating. An additional task is to compile historical NOAA tide gauge data and NGS geodetic data to estimate historical vertical uplift rates.
3. Paleoseismic Trenching: Paleoseismic trenching is planned in order to estimate slip rates and obtain paleoearthquake chronologies along the Rose Canyon section of the NI/RC fault zone.
4. Seismic Monitoring: The installation of additional permanent onshore seismographic stations in order to obtain denser station coverage in the vicinity of SONGS is planned. Data will be telemetered to the Southern California Earthquake Data Center (SCEC) and be part of the California Integrated Seismographic Network (CISN). A temporary network of Ocean Bottom Seismometers (OBS) is also

planned for a 3-year deployment offshore. This deployment is tentative, planned during the proposed 3-D deep surveys.

Summary

The Seismic Research Projects overview presented by SCE represents an ambitious plan to increase the understanding of seismotectonics in the vicinity of SONGS. A number of projects (installation of seismographs and continuous GPS stations, on-shore paleoseismic trenching studies and geologic mapping, reprocessing of older geophysical data) are low-risk projects that use standard data collection and processing techniques, or integrate into regional monitoring programs (e.g. SCIGN, CISN) already in place that will likely produce results useful in seismic hazard analysis. In contrast, many of the offshore programs, particularly the deep 2-D and 3-D seismic surveys, are higher risk projects given the technical challenges of successfully imaging faults in the deeper crust. SCE acknowledges this challenge and has designed a phased data acquisition program. First, the 2-D seismic imaging studies will take place prior to any 3-D seismic imaging studies. In this way, appropriate targets for both the deep and shallow 3-D studies can be identified ahead of time. Additionally, the 2-D deep imaging program will serve as a feasibility study in order to assess whether faults can be imaged at deeper levels in the crust, especially within the Catalina schist, where the geology may not be conducive to the imaging of faults. If faults cannot be imaged within the Catalina schist, a 3-D deep survey may not be warranted. Currently, SCE is considering a 10 day window of data acquisition, consisting of 27 fault perpendicular lines and 6 strike (shore-parallel) lines. If SCE considers a 2-D survey of shorter duration, it should be conducted to ensure a sufficient area is imaged so that the potential for successfully imaging faults within the Catalina Schist can be adequately evaluated, and target structures identified so the investigators can evaluate whether the 3-D deep surveys are worth pursuing.

Finally, the IPRG notes that SCE's Seismic Research Projects program has so far focused on the seismic source characterization aspect of the seismic hazard analysis. Not addressed by SCE at this meeting are the ground motion aspects of the seismic hazard analysis, which are equally or more important. Recent proposed changes in some details of ground motion calculation can have significant impact on the calculated hazard. The IPRG is interested in learning about this aspect of SCE's analysis and suggests that the topic for a future meeting will cover the ground motion analysis aspects of the seismic hazard analysis with respect to SONGS.

IPRG membership:

California Geological Survey

California Coastal Commission

California Emergency Management Agency

California Energy Commission

California Seismic Safety Commission

California Public Utilities Commission